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A More Rational Ranking System in Olympic Games

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Abstract: We analyze the final results of the 2002 Salt Lake City and the 1998 Nagano Winter Olympic Games as well as the 2000 Sydney Summer Olympic Games. Instead of ranking countries by total number of winning medals, we propose a new ranking by standardizing a weighted sum of the number of medals by population size.

Key Words: Olympic data, ranking.

1 Introduction

The 2002 Salt Lake City Winter Olympic Games are now closed in the USA, and, despite of de Coubertin's maxime 'The important thing is to participate', all newspapers in the whole planet exhibited only ranking of nations with the count of gold, silver and bronze medals, and celebrated as modern heroes, their athlets. The final olympic table ranks nations by either the total number of medals obtained, or only by the number of gold medals first, then silver and bronze, or by giving a unique score with special weights to gold, silver and bronze.

The aim of this note is an attempt to present a more rational ranking system. We see that if we slightly modify the ranking criteria, small nations in population size will have a better ranking as compare to the actual system.

2 Current ranking

There are basically three ways of ranking the winning nations in any Olympic games. The first one consists of using a criterion for ranking nations in Olympic games is the lexicographic order of medals. Nation A is better placed than B if A has more gold medals than B. When A and B have the same number of gold medals, A is better

placed than B if A has more silver medals, and so on. This is the most common method of ranking nations in the final table. The media often use this method of ranking. In this method a nation with a unique gold medal is ranked better than a nation with an arbitrarily large number of silver and bronze medals.

A second method, consits of ranking nations by total number of winning medals. The official web site of the Salt Lake City Olympic Games [3] employs this method. The problem with this way of ranking is that a nation may have 20 bronze medals and gets a better ranking than a nation with 19 gold medals.

A third method of ranking the winning nations which is more rational and takes into account the drawbacks of the above two methods can be described as follows. Let P be defined as

$$P = 3 \times (\text{No. of gold medals}) + 2 \times (\text{No. of silver medals}) + \text{No. of bronze medals.}$$

The ranking of nations is determined by decreasing values of the score P. This method is used for example in [2] , where is applied to produce a ranking for each edition of Olympic games. Table 1 and 2 respectively show the ranking of nations for the Nagano 1998 and Salt Lake City 2002 Winter Olympic Games using the third methods, according to the score P.

	Nation	Gold	Silver	Bronze	Total	P
1	Germany	12	9	8	29	62
2	Norway	10	10	5	25	55
3	Russia	9	6	3	18	42
4	Canada	6	5	4	15	32
5	USA	6	3	4	13	28
5	Austria	3	5	9	17	28
7	Netherlands	5	4	2	11	25
8	Japan	5	1	4	10	21
9	Italy	2	6	2	10	20
9	Finland	2	4	6	12	20
11	China	0	6	2	8	14
12	South Korea	3	1	2	6	13
12	Switzerland	2	2	3	7	13
12	France	2	1	5	8	13
15	Czech Republic	1	1	1	3	6
16	Sweden	0	2	1	3	5
17	Bulgaria	1	0	0	1	3
18	Ukraine	0	1	0	1	2
18	Denmark	0	1	0	1	2
18	Belarus	0	0	2	2	2
18	Kazakhztan	0	0	2	2	2
22	United Kingdom	0	0	1	1	1
22	Belgium	0	0	1	1	1
22	Australia	0	0	1	1	1

Table 1. Ranking of winning nations according to the score P. Nagano 1998.

To compare the three methods described above, take Austria as an example. For the Salt Lake City Winter Olympic Games, with the method one, sorting by gold medals first, Austria is ranked in the 12th position, while with the second method, ranking by total number of medals, it is ranked in the 5th position and with the third method, according to the P score, it is ranked in the 6th position.

The third method which is based on the P score has also a drawback. Take for example the Nagano Winter Olympic Games. From Table 1 we see that if we use the P score, China with no gold medal gets better ranking than France with two gold

medals. This happens because the number of silver medals of China are superior than that of France. Hence, China is in 11th place, and France is in the 12th place .

	Nation	Gold	Silver	Bronze	Total	P
1	Germany	12	16	7	35	75
2	USA	10	13	11	34	67
3	Norway	11	7	6	24	53
4	Russia	6	6	4	16	34
5	Canada	6	3	8	17	32
6	Austria	2	4	10	16	24
6	Italy	4	4	4	12	24
6	France	4	5	2	11	24
9	Switzerland	3	2	6	11	19
9	Netherlands	3	5	0	8	19
11	Finland	4	2	1	7	17
12	China	2	2	4	8	14
13	Croatia	3	1	0	4	11
14	South Korea	2	2	0	4	10
15	Sweden	0	2	4	6	8
16	Estonia	1	1	1	3	6
16	Australia	2	0	0	2	6
16	Spain	2	0	0	2	6
19	United Kingdom	1	0	2	3	5
20	Bulgaria	0	1	2	3	4
20	Czech Republic	1	0	1	2	4
22	Japan	0	1	1	2	3
22	Poland	0	1	1	2	3
24	Belarus	0	0	1	1	1
24	Slovenia	0	0	1	1	1

Table 2. Ranking of winning nations according to the score P. Salt Lake City 2002.

Now suppose, in addition to the weights furnished by the third method, we add another element of importance, the population size of a winning nation, into consideration. If a country of a small size, for example 7 or 11 millions, win a bronze medal, it should be ranked better than a country with say 350 millions with the same bronze medal. We think it is more rational to bring the population size into account in ranking the nations for the final olympic results. This new weight, the population size, is an attempt to make a new adjustment for ranking nations.

3 Ranking: A proposition

Let Q be defined as $Q = P \cdot 10^6/\text{Population}$. Here we considered the data of populations for 1998 one can find in [1] . Table 3 shows the Nagano 1998 and Salt Lake City Winter Olympic Games ranking according to the Q score.

The result of this scoring shows that highest positions are occupied by countries of a medium size where winter sports are very popular. Moreover, as we all know, the winter sports are rather expensive and not all nations, specially the southern nations, can participate in such events.

The same idea can be applied to the Summer Olympic Games. For example, we can apply the Q score method to the Sydney 2000 Summer Olympic Games where more countries participated.

	Nagano1998				Salt Lake City 2002		
Rank	Nation	Pop.(10^6)	Q	Rank	Nation	Pop.(10^6)	Q
1	Norway	4.42	12.4434	1	Norway	4.42	11.9910
2	Finland	5.15	3.8835	2	Estonia	1.42	4.2254
3	Austria	8.13	3.4440	3	Finland	5.15	3.3010
4	Switzerland	7.26	1.7906	4	Austria	8.13	2.9520
5	Netherlands	15.73	1.5893	5	Switzerland	7.26	2.6171
6	Canada	30.68	1.0430	6	Croatia	4.67	2.3555
7	Germany	82.08	0.7554	7	Netherlands	15.73	1.2079
8	Czech Republic	10.29	0.5831	8	Canada	30.68	1.0430
9	Sweden	8.89	0.5624	9	Germany	82.08	0.9137
10	Denmark	5.33	0.3752	10	Sweden	8.89	0.8999
11	Bulgaria	8.24	0.3641	11	Slovenia	1.97	0.5076
12	Italy	56.78	0.3522	12	Bulgaria	8.24	0.4854
13	Russia	146.86	0.2860	13	Italy	56.78	0.4227
14	South Korea	46.42	0.2801	14	France	58.81	0.4081
15	France	58.81	0.2211	15	Czech republic	10.29	0.3887
16	Belarus	10.41	0.1921	16	Australia	18.61	0.3224
17	Japan	125.93	0.1668	17	USA	270.31	0.2479
18	Kazakhztan	16.85	0.1187	18	Russia	146.86	0.2315
19	USA	270.31	0.1036	19	South Korea	46.42	0.2154
20	Belgium	10.18	0.0982	20	Spain	39.13	0.1533
21	Australia	18.61	0.0537	21	Belarus	10.41	0.0961
22	Ukraine	50.13	0.0399	22	United Kingdom	57.72	0.0866
23	United Kingdom	57.72	0.0173	23	Poland	38.61	0.0777
24	China	1236.92	0.0113	24	Japan	125.93	0.0238
				25	China	1236.92	0.0113

Table 3. Ranking nations according to Q.

A summary of results for the Summer Olympic Games held in Sydney 2000 is given in Table 4, and the ranking according to Q score method is shown in Table 5.

	Nation	Gold	Silver	Bronze	Total	P	Pop.(10^6)	Q
1	USA	39	25	32	96	199	270.31	0.7362
2	Russia	32	27	29	88	179	146.86	1.2188
3	China	28	16	15	59	131	1236.91	0.1059
4	Australia	16	25	17	58	115	18.61	6.1795
5	Germany	14	17	25	56	101	82.07	1.2307
6	France	13	14	11	38	78	58.80	1.3265
7	Italy	13	8	13	34	68	56.78	1.1976
8	Cuba	11	11	7	29	62	11.04	5.6159
9	United Kingdom	11	10	7	28	60	57.72	1.0395
10	Netherlands	12	9	4	25	58	15.73	3.6872
11	Romania	11	6	9	26	54	22.40	2.4107
12	South Korea	8	9	11	28	53	46.42	1.1417
13	Ukraine	3	10	10	23	39	50.13	0.7780
14	Hungary	7	6	3	16	36	10.21	3.5260
15	Japan	5	8	5	18	36	125.93	0.2859
16	Poland	6	5	3	14	31	38.61	0.8029
17	Bulgaria	5	6	2	13	29	8.24	3.5194
18	Greece	4	6	3	13	27	10.66	2.5328
19	Belarus	3	3	11	17	26	10.41	2.4976
20	Sweden	4	5	3	12	25	8.89	2.8121
21	Canada	3	3	8	14	23	30.68	0.7497
22	Norway	4	3	3	10	21	4.42	4.7511
23	Spain	3	3	5	11	20	39.13	0.5111
24	Brazil	0	6	6	12	18	169.81	0.1060
25	Ethiopia	4	1	3	8	17	58.39	0.2911
26	Kazakhstan	3	4	0	7	17	16.85	1.0089
27	Switzerland	1	6	2	9	17	7.26	2.3416
28	Czech Republic	2	3	3	8	15	10.29	1.4577
29	Kenya	2	3	2	7	14	28.34	0.4940
30	Denmark	2	3	1	6	13	5.33	2.4390
31	Indonesia	1	3	2	6	11	212.94	0.0517
32	Jamaica	0	4	3	7	11	2.64	4.1667
33	Turkey	3	0	1	4	10	64.57	0.1549

	Nation	Gold	Silver	Bronze	Total	P	Pop.(10^6)	Q
34	Iran	3	0	1	4	10	68.96	0.1450
35	Slovakia	1	3	1	5	10	5.39	1.8553
36	Mexico	1	2	3	6	10	98.55	0.1015
37	Finland	2	1	1	4	9	5.15	1.7476
38	Lithuania	2	0	3	5	9	3.60	2.5000
39	Austria	2	1	0	3	8	8.13	0.9840
40	Algeria	1	1	3	5	8	30.48	0.2625
41	Azerbaijan	2	0	1	3	7	7.86	0.8906
42	Uzbekistan	1	1	2	4	7	23.78	0.2944
43	Belgium	0	2	3	5	7	10.18	0.6876
44	South Africa	0	2	3	5	7	42.84	0.1634
45	Slovenia	2	0	0	2	6	1.97	3.0457
46	Serbia and Montenegro	1	1	1	3	6	11.21	0.5352
47	Latvia	1	1	1	3	6	2.39	2.5105
48	New Zealand	1	0	3	4	6	3.63	1.6529
49	Nigeria	0	3	0	3	6	110.53	0.0543
50	Argentina	0	2	2	4	6	36.27	0.1654
51	Taiwan	0	1	4	5	6	21.91	0.2738
52	Morocco	0	1	4	5	6	29.11	0.2061
53	Georgia	0	0	6	6	6	5.11	1.1742
54	Bahamas	1	1	0	2	5	0.28	17.8571
55	Thailand	1	0	2	3	5	60.03	0.0833
56	Estonia	1	0	2	3	5	1.42	3.5211
57	North Korea	0	1	3	4	5	22.18	0.2254
58	Croatia	1	0	1	2	4	4.67	0.8565
59	Mozambic	1	0	0	1	3	18.64	0.1609
60	Colombia	1	0	0	1	3	38.58	0.0778
61	Cameroon	1	0	0	1	3	15.03	0.1996
62	Saudi Arabia	0	1	1	2	3	20.79	0.1443
63	Moldova	0	1	1	2	3	4.46	0.6726
64	Trinidad and Tobago	0	1	1	2	3	1.12	2.6786
65	Vietnam	0	1	0	1	2	76.24	0.0262
66	Uruguay	0	1	0	1	2	3.29	0.6079
67	Ireland	0	1	0	1	2	3.62	0.5525
68	Portugal	0	0	2	2	2	9.93	0.2014
69	Costa Rica	0	0	2	2	2	3.61	0.5540
70	Barbados	0	0	1	1	1	0.26	3.8462
71	Kyrghyzstan	0	0	1	1	1	4.52	0.2212
72	Armenia	0	0	1	1	1	3.42	0.2924
73	Qatar	0	0	1	1	1	0.70	1.4286
74	Sri Lanka	0	0	1	1	1	18.93	0.0528
75	Kuwait	0	0	1	1	1	1.91	0.5236
76	Israel	0	0	1	1	1	5.64	0.1773
77	Iceland	0	0	1	1	1	0.27	3.7037
78	India	0	0	1	1	1	983.38	0.0010
79	Chile	0	0	1	1	1	14.68	0.0681

Table 4. Data of Summer Olympic Games, Sydney 2000.

The results of the Table 5 show an unexpected homogeneity. In best positions we have several Caribbean countries, as well as the host country, Australia. European countries of different sizes get lower ranking. Except for Russia, large countries such as USA, China, Japan, Brazil, have a modest ranking, and they have a ranking comparable to that of most emergent countries.

The ranking proposed in this paper according to Q score method standardizes the number of medals by population size. The score Q can be considered as a measure of the popularity of certain disciplines, namely Olympic sports. Of course, one can combine many other socio-economic and geographic factors, the number of participating athlets for each nation, and so on to come up with a more accurate and optimal measure of ranking. A nice problem!

Rank	Nation	Q	Rank	Nation	Q
1	Bahamas	17.8571	41	USA	0.7362
2	Australia	6.1795	42	Belgium	0.6876
3	Cuba	5.6159	43	Moldova	0.6726
4	Norway	4.7511	44	Uruguay	0.6079
5	Jamaica	4.1667	45	Costa Rica	0.5540
6	Barbados	3.8462	46	Ireland	0.5525
7	Iceland	3.7037	47	Serbia and Montenegro	0.5352
8	Netherlands	3.6872	48	Kuwait	0.5236
9	Hungary	3.5260	49	Spain	0.5111
10	Estonia	3.5211	50	Kenya	0.4940
11	Bulgaria	3.5194	51	Uzbekistan	0.2944
12	Slovenia	3.0457	52	Armenia	0.2924
13	Sweden	2.8121	53	Ethiopia	0.2911
14	Trinidad and Tobago	2.6786	54	Japan	0.2859
15	Greece	2.5328	55	Taiwan	0.2738
16	Latvia	2.5105	56	Algeria	0.2625
17	Lithuania	2.5000	57	North Korea	0.2254
18	Belarus	2.4976	58	Kyrghyzstan	0.2212
19	Denmark	2.4390	59	Morocco	0.2061
20	Romania	2.4107	60	Portugal	0.2014
21	Switzerland	2.3416	61	Cameroon	0.1996
22	Slovakia	1.8553	62	Israel	0.1773
23	Finland	1.7476	63	Argentina	0.1654
24	New Zealand	1.6529	64	South Africa	0.1634
25	Czech Republic	1.4577	65	Mozambic	0.1609
26	Qatar	1.4286	66	Turkey	0.1549
27	France	1.3265	67	Iran	0.1450
28	Germany	1.2307	68	Saudi Arabia	0.1443
29	Russia	1.2188	69	Brazil	0.1060
30	Italy	1.1976	70	China	0.1059
31	Georgia	1.1742	71	Mexico	0.1015
32	South Korea	1.1417	72	Thailand	0.0833
33	United Kingdom	1.0395	73	Colombia	0.0778
34	Kazakhstan	1.0089	74	Chile	0.0681
35	Austria	0.9840	75	Nigeria	0.0543
36	Azerbaijan	0.8906	76	Sri Lanka	0.0528
37	Croatia	0.8565	77	Indonesia	0.0517
38	Poland	0.8029	78	Vietnam	0.0262
39	Ukraine	0.7780	79	India	0.0010
40	Canada	0.7497			

Table 5. Ranking according to Q score.

References

[1] U.S. Bureau of the Census, Report WP/98, *World Population Profile: 1998*, U.S. Government Printing Office, Washington, DC, 1999.
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